

GBD: CHANGES IN SIGNS/EFFECTS ON SURVIVAL

9602400

SHORT DESCRIPTION:

PIT-tagged run-of-the-river hatchery fish will be exposed to water containing supersaturated dissolved atmospheric gasses, examined for signs of GBD, and released into the forebay of Little Goose Dam. A percentage of these fish will be recaptured at the Little Goose Dam collection facility and reexamined to determine changes in GBD signs attributable to increased hydrostatic pressure during passage into the juvenile salmon bypass system. Treatment and control groups will be interrogated at PIT-tag detector systems at downstream dams to evaluate survival differences.

SPONSOR/CONTRACTOR: NMFS

National Marine Fisheries Service, Coastal Zone and Estuarine
Studies Division

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GOALS

GENERAL:

Supports a healthy Columbia basin, Adaptive management (research or M&E)

ANADROMOUS FISH:

Research, M&E

NPPC PROGRAM MEASURE:

5.6C.2;5.6E.1

RELATION TO MEASURE:

Two important questions remain unanswered regarding the effectiveness of biological monitoring to evaluate impacts to juvenile salmonids from GBD: 1) Do signs of GBD change as a result of changing hydrostatic pressure experienced by juvenile salmonids during their passage through turbine intakes, gatewells, and bypass conduits of dams?, and 2) Do the physical detriments from GBD cause a decrease in survival resulting from direct indirect effects such as predation during migration through reservoirs? Not addressing these questions may limit the use of spill for improving fish passage at dams. Proponents of the theories that signs of GBD in juvenile salmonids disappear prior to examination by smolt monitoring personnel at dams, and/or that all fish with signs of GBD die or are eaten by predators prior to

BIOLOGICAL OPINION ID:

NMFS Hydrosystem Operations Biological Opinion (Action Number 16)

OTHER PLANNING DOCUMENTS:

Snake River Salmon Recovery Plan (Task 2.2.d.4) NMFS Gas Bubble Disease Research Priorities Document

TARGET STOCK

Snake River Hatchery Steelhead

Snake River Spring/Summer Chinook Salmon

LIFE STAGE

Smolt

Smolt

MGMT CODE (see below)

L, W

BACKGROUND

Subbasin:

Lower Snake and Columbia River

HISTORY:

The NMFS Gas Bubble Disease Research Priorities document identifies this research approach as one method for evaluating two critical uncertainties: 1) Do GBD sampling protocols for juvenile salmonids at dams produce data which properly represent fish populations in the river? 2) Does prevalence and severity of GBD at the sampling sites indicate mortality from GBD occurring upstream from the monitoring sites.

BIOLOGICAL RESULTS ACHIEVED:

Data obtained in 1996 identified a decrease in prevalence and severity of GBD signs in steelhead released 0.5 km upstream from the dam. A smaller decrease in prevalence and severity was observed in fish held in a 5-m deep net-pen.

No statistical difference in survival was observed for GBD-challenged steelhead compared with unchallenged counterparts, either at passage through Little Goose Dam or at passage through the other dams downstream.

Additional tests are necessary to separate the effects of hydrostatic pressure during dam passage from the effects of the depth distribution during reservoir residence on GBD signs. Faster recovery of fish passing through the dam will be necessary.

Because fish size may be of significant importance in rate of predation, smaller juvenile salmon must be used in a similar GBD challenge test to confirm that survival is not decreased. Exclusive use of juvenile steelhead for these tests may have resulted in a conservative estimate for decreases in survival associated with GBD effects during migration. Recent results from laboratory tests of juvenile salmon suggested higher predation by northern squawfish for fish exposed to dissolved gas supersaturation than for unexposed cohorts (Matthew Mesa, National Biological Service, Cook, WA., pers. commun.) However, compared with juvenile salmon migrants, the greater size and speed of steelhead likely decreases predation by fish and birds..

PROJECT REPORTS AND PAPERS:

Annual report in preparation.

ADAPTIVE MANAGEMENT IMPLICATIONS:

Potential changes in signs of GBD that may result from fish passing through juvenile bypasses (pressure effects) raises concerns regarding the representativeness of fish sampling at dams for GBD evaluation. Resolving this question is critical to ensure information used for river operations management is adequate for addressing potential risks associated with DGS and GBD. Similarly, improved understanding of the effects of GBD on survival will allow better informed operational decision-making in managing spill and choosing fish passage pathways.

PURPOSE AND METHODS

SPECIFIC MEASUREABLE OBJECTIVES:

We will measure changes in signs of GBD (external subcutaneous emphysema) in juvenile salmonids as they migrate through a bypass/collection facility at Little Goose Dam. Such changes could be induced by the sounding required by the fish to enter the gatewells before migrating through the rest of the system. We will also measure relative survival of juvenile salmonids allowed to migrate after exposure to levels of supersaturated atmospheric gases that induced signs of GBD in about 50% of the population.

CRITICAL UNCERTAINTIES:

The juvenile steelhead used in the tests represent a portion of the downstream migrating salmonid population, and their larger size and behavioral differences from chinook and sockeye salmon may have produced results that are indicative for steelhead only. Experimental exposure may not impact test fish in the same manner that river-run fish are impacted by GBD; results, therefore, may not be representative. Risks to non-target previously PIT-tagged fish by excessive handling are minimized through installation of a separation-by-code diverter at Little Goose Dam.

BIOLOGICAL NEED:

This study has been designed to answer 1) if migrating juvenile salmonids lose signs of GBD while passing through a bypass/collection facility, and 2) if fish exposed to supersaturated dissolved gasses die in the reservoir before reaching bypass/collection facilities. Answers to these questions will help determine the usefulness of monitoring sites at dams in detecting signs of GBD in migrating salmonids and identifying potential mortality upstream from the monitoring site.

HYPOTHESIS TO BE TESTED:

Hypothesis 1: Juvenile salmonids with signs of GBD do not lose these signs by passage through a gatewell into bypass systems at dams on the Snake or Columbia Rivers. Hypothesis 2: An increase in mortality of juvenile salmonids with GBD does not affect the ability to detect signs of GBD at bypass/collection facilities on the Snake or Columbia Rivers.

ALTERNATIVE APPROACHES:

Other approaches are being conducted--survival assessments using PIT-tag interrogations at dams, and riverine sampling for GBD in juvenile salmon to compare with data from samples at dams. Because each approach has inherent problems, we need to conduct all of the studies to resolve the questions.

JUSTIFICATION FOR PLANNING:

The potential for unidentified mortality from effects of GBD is unacceptable.

METHODS:

To provide enough fish for a statistically valid assessment of changes in GBD signs during dam passage, 6 replicate releases of 300 test fish will be made for each of the 3 test series (yearling chinook salmon and steelhead). Similar sized groups of control fish will be released and 150-fish groups exposed to supersaturation will be retained in 5-m net-pens in the forebay. Test and control groups will be anesthetized and PIT tagged. Fish groups will be placed into separate but identical holding tanks with degassed river water at densities less than 60 g/L (0.50 lb/gal.). The dissolved gas levels in the test fish tank will be increased to and held at about 120% of saturation using a bubbleless membrane aeration system installed in the water line. Both control and test fish will be held an additional 1 to 2 days until about 50% of the test fish display signs of GBD.

For each test replicate, when prevalence of GBD signs reaches 50% or mortality begins, test fish will be extracted (in small groups), anesthetized, and visually examined at 5- to 20-power magnification for subcutaneous emphysema and emboli in lateral line scale pockets. Severity of emphysema will be assessed as percentage of body area affected and relative size and shape of emboli. Coincidentally, control fish will be extracted, anesthetized, and a subsample examined for GBD, while others will be held out of the water for approximately the time required for GBD examination. After examination, half the test and control fish will be placed in a common tank, transported, and released about 400 m upstream from the Little Goose Dam powerhouse. Since the examination process will take an extended period of time, multiple releases will be made. We plan to make the releases near dusk to facilitate rapid passage through the dam and bypass system. The other half will be released directly in front of the operating turbine to facilitate rapid passage.

Signs of GBD among test fish may be changing during the period prior to passage through the dam. Therefore, a third group of PIT-tagged fish from the supersaturated test condition will be examined and then placed in a forebay net-pen (5-m deep) to allow documentation of changes in GBD signs through time at ambient dissolved gas concentrations in Little Goose Dam forebay.

Using a mechanical gate to separate PIT tags by code, test and control fish will be automatically separated from other fish passing through the bypass system at Little Goose Dam and examined immediately to determine any changes in the prevalence and severity of GBD signs. Interrogation of PIT-tagged test and control fish at Little Goose, Lower Monumental, Ice Harbor, and McNary Dams will provide an estimate of differential survival during migration.

Approximately 5,000 hatchery fish will be needed for each test series. Possible fish sources include: 1) Marked hatchery steelhead could be sorted from the Little Goose or Lower Granite Dam collection system. 2) Yearling chinook salmon from Lookingglass, Lyons Ferry, or Kooskia Hatcheries.

PLANNED ACTIVITIES

SCHEDULE:

<u>Planning Phase</u>	<u>Start</u> January	<u>End</u> March	<u>Subcontractor</u>
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<u>Task</u> Design test, locate test fish, obtain PIT tags			
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<u>Implementation Phase</u>	<u>Start</u> March	<u>End</u> July	<u>Subcontractor</u>
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<u>Task</u> Holding, testing, and examination facilities. Commence testing. Tests with yearling chinook salmon will commence in mid- to late April, about 1 week following fish transfer to the site and steelhead will be tested in mid- to late May. Each test series is expected to take 2-3 weeks.			
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<u>O&M Phase</u>	<u>Start</u> August	<u>End</u> January	<u>Subcontractor</u>
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<u>Task</u> All facilities are temporary and will be disassembled in July. Following completion of testing, efforts will be directed to analysis of data and reporting results.			
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PROJECT COMPLETION DATE:

1999

CONSTRAINTS OR FACTORS THAT MAY CAUSE SCHEDULE OR BUDGET CHANGES:

Lack of test fish availability may cause changes in the scope of the tests. The only known risk is the inadvertent handling of in-river migrants which are PIT tagged as part of other up river projects. With installation and preliminary testing of a rotating gate at Little Goose Dam, separation by code appears to be about 95% efficient--as seen at Lower Granite Dam during testing and in use as part of a subyearling study (Sandra Downing, NMFS, Manchester, WA, pers. comm.) .

OUTCOMES, MONITORING AND EVALUATION

SUMMARY OF EXPECTED OUTCOMES

Expected performance of target population or quality change in land area affected:

All data shall be analyzed by the December 1998. This will produce a database which should help answer questions to the critical uncertainties mentioned above.

Present utilization and conservation potential of target population or area:

Normal production

Assumed historic status of utilization and conservation potential:

N/A

Long term expected utilization and conservation potential for target population or habitat:

N/A

Contribution toward long-term goal:

Validation of GBD sampling data at dams and knowledge of survival related to GBD.

Indirect biological or environmental changes:

None.

Physical products:

5,000 PIT-tagged chinook salmon and steelhead.

Environmental attributes affected by the project:

N/A

Changes assumed or expected for affected environmental attributes:

N/A

Measure of attribute changes:

N/A

Assessment of effects on project outcomes of critical uncertainty:

Examination of non-target fish percentages will allow adjustment of the PIT-tag selector gate to accommodate a low rate of error.

Information products:

Percentages of GBD signs loss and change, and diminished survival from GBD impacts to juvenile salmonids during migration.

Coordination outcomes:

FPC and BRD will utilize results to reevaluate efficacy of current GBD monitoring protocols for juvenile salmonids.

MONITORING APPROACH

(See Methods section)

Provisions to monitor population status or habitat quality:

N/A

Data analysis and evaluation:

Statistical analysis using ANOVA.

Information feed back to management decisions:

If based on results of these tests, it is apparent that the assessment error rate (signs change) is a high percentage and/or survival is decreased, and other studies by CRITFC, Cramer, and NMFS (identified earlier) corroborate these findings, then steps must be taken to obtain more representative samples for regional GBD assessment.

Critical uncertainties affecting project's outcomes:

Based on results from 1996, non-target fish captures appear to be within acceptable ranges for continuing research. Lack of appropriate test fish will delay conduct of this research.

EVALUATION

Results to be evaluated will be observed changes in signs and survival and the precision of those measurements.

Incorporating new information regarding uncertainties:

Through discussions with investigators and the contracting officers technical representative.

Increasing public awareness of F&W activities:

Dissemination of results via written reports, publications, presentations at meetings.

RELATIONSHIPS

RELATED BPA PROJECT

9303100 Symptoms of Gas Bubble Trauma in Juvenile Salmon in the Snake and Columbia River, CRITFC.

5500100 Smolt migration survival assessment through PIT tag evaluations.

9302900 Survival estimates for the passage of yearling chinook salmon and steelhead through Snake River dams and reservoirs

5503400

5515600 GBD monitoring of juvenile salmonids under FPC.

RELATIONSHIP

Provides validation for data developed regarding changes in signs of GBD during dam passage.

Provides validation for data regarding survival changes associated with exposure to dissolved gas supersaturation.

Provides validation for speculation of decreased survival associated with exposure to dissolved gas supersaturation.

Data gained in this study will provide evaluation of efficacy of GBD monitoring protocols at dams. If GBD signs are changing as a result of passage through the bypass/collection system at dams, or if GBD signs are not seen because of mortality upstream, locations of monitoring sites and/or other methods of monitoring GBD (i.e., purse seines, trawls, or traps) may be required.

COSTS AND FTE

1997 Planned: \$228,000

FUTURE FUNDING NEEDS:

<u>FY</u>	<u>\$ NEED</u>	<u>% PLAN</u>	<u>% IMPLEMENT</u>	<u>% O AND M</u>
1998	\$280,000	0%	100%	0%
1999	\$280,000	0%	100%	0%
2000	\$0	0%	0%	0%
2001	\$0	0%	0%	0%
2002	\$0	0%	0%	0%

PAST OBLIGATIONS (incl. 1997 if done):

<u>FY</u>	<u>OBLIGATED</u>
1996	\$251,600

TOTAL: \$251,600

Note: Data are past obligations, or amounts committed by year, not amounts billed. Does not include data for related projects.

FY OTHER FUNDING SOURCE

1998	NMFS
1999	NMFS

AMOUNT IN-KIND VALUE

\$100,000	\$20,000
\$100,000	\$20,000

OTHER NON-FINANCIAL SUPPORTERS:

N/A

LONGER TERM COSTS: N/A

1997 OVERHEAD PERCENT: 45.6% of total direct labor charges.

HOW DOES PERCENTAGE APPLY TO DIRECT COSTS:

total direct labor charges only.

CONTRACTOR FTE: 4 NMFS employees.

SUBCONTRACTOR FTE: N/A